Collagen Nerve Wrap for Median Nerve Scarring

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Abstract: Nerve wrapping materials have been manufactured to inhibit nerve tissue adhesions and diminish inflammatory and immunologic reactions in nerve surgery. Collagen nerve wrap is a biodegradable type I collagen material that acts as an interface between the nerve and the surrounding tissues. Its main advantage is that it stays in place during the period of tissue healing and is then gradually absorbed once tissue healing is completed. This article presents a surgical technique that used a collagen nerve wrap for the management of median nerve tissue adhesions in 2 patients with advanced carpal tunnel syndrome due to median nerve scarring and adhesions. At last follow-up, both patients had complete resolution with no recurrence of their symptoms. Complications related to the biodegradable material were not observed. [Orthopedics. 2015; 38(2):117-121.]

Although carpal tunnel release is a successful surgical procedure, complications and treatment failures occur in 14% to 32% of the cases.1-5 Recurrent carpal tunnel syndrome as a result of recurrent entrapment neuropathy due to nerve tissue adhesions is a common complication of primary surgery. In these cases, reoperation for nerve decompression and release of nerve tissue adhesions is necessary.5 Some surgeons recommend simple external neurolysis or internal neurolysis of the median nerve in patients with recurrent carpal tunnel syndrome,7 while other surgeons support the role of supplementary techniques to protect the nerve from scarring. Such techniques include various types of muscle, subcutaneous, or synovial tissue flaps,8-13 or wrapping the median nerve with an autologous vein graft.14,16 The disadvantages of autologous tissue techniques include donor site morbidity, risk of surgical complications, and often limited availability of autologous material for coverage. In this setting, synthetic materials for nerve wrapping could be beneficial for nerve protection from tissue adhesions.

Collagen nerve wrap (NeuraWrap Nerve Protector; Integra LifeSciences Corporation, Plainsboro, New Jersey) is an absorbable collagenous implant that provides a nonconstricting encasement for injured peripheral nerves for protection of the neural environment. NeuraWrap Nerve Protector is designed to be used as an interface between the nerve and the surrounding tissue. Once hydrated, it transforms into a soft, pliable, nonfriable, porous collagen conduit that is easy to handle. The wall of the nerve wrap has a longitudinal slit that allows it to be cut for easy placement around the injured nerve. NeuraWrap Nerve Protector is available in sterile, double peel packages in a variety of sizes for single use only.

This article describes a surgical technique that used the NeuraWrap Nerve Protector for 2 patients with symptoms of carpal tunnel syndrome due to scar tissue formation around the median nerve. Both patients gave written informed consent for their data to be reported.

Case Reports

Patient 1

A 34-year-old right-hand–dominant woman presented with pain, hyperesthesia, and numbness of the right index and middle fingers. She report-
ed a history of 2 unsuccessful open carpal tunnel surgeries for persistent carpal tunnel syndrome symptoms. Clinical examination at presentation showed a positive Tinel sign over the carpal tunnel and a greater than 10-mm static 2-point discrimination test at the index and middle fingers. Median nerve conduction studies confirmed the clinical diagnosis of recurrent carpal tunnel syndrome. Reoperation for release of median nerve tissue adhesions was recommended.

Patient 2

A 70-year-old man was admitted to the authors’ hospital with severe pain and numbness of the left hand 1 year after left wrist trauma. At that time, he had undergone acute surgery; however, details of the surgery were not available. Clinical examination at presentation showed a positive Tinel sign over the carpal tunnel, distribution of the pain and numbness in the median nerve, and limited active thumb flexion, which, according to the patient, was evident after the initial surgery. Median nerve conduction studies confirmed the clinical diagnosis of carpal tunnel syndrome. Reoperation for release of median nerve tissue adhesions was recommended.

SURGICAL TECHNIQUE

Both procedures were performed under axillary nerve block anesthesia with the use of a pneumatic tourniquet. A standard open carpal tunnel approach was used incorporating the previous incision extended proximally and distally. Extension of the incision is necessary to expose the compressed nerve in a healthy bed without scar tissue. In both patients, extensive scarring and hourglass deformity of the median nerve was found. Scar tissue was excised and the median nerve was thoroughly released with external neurolysis (Figure 1). In Patient 2, a partial laceration of the flexor pollicis longus tendon was also observed (Figure 2).

Next, an appropriate length of collagen nerve wrap (NeuraWrap Nerve Protector) was selected and cut longitudinally according to the length of nerve release. The collagen nerve wrap was rinsed with saline to soften it and permit easier handling. The NeuraWrap Nerve Protector was carefully circumferentially applied so as not to be tight and potentially constrict the nerve. Then, the collagen nerve wrap was loosely sutured with separate No. 7-0 polypropylene sutures (Prolene; Ethicon Inc, Somerville, New Jersey) across the longitudinal cut (Figure 3). In Patient 2, repair of the flexor pollicis longus tendon was done with a 1.5-cm palmaris longus tendon autograft.

The tourniquet was then deflated, and meticulous hemostasis was performed. Skin closure was done with separate No. 4-0 nylon sutures, and a dorsal splint was applied. The skin sutures were removed 10 days after the operation, and the dorsal splint was discontinued at 3 weeks, followed by progressive passive and active range of motion rehabilitation exercises for the wrist and fingers.

At last follow-up, 18 and 20 months for Patients 1 and 2, respectively, both patients were asymptomatic. A Tinel sign was absent and the static 2-point discrimination test at the index and middle fingers was 3 to 5 mm. Values on median nerve conduction studies performed for the purpose of this study were significantly improved compared with preoperative values.

DISCUSSION

Recurrent or posttraumatic carpal tunnel syndrome may occur in 3% to 23% of patients due to nerve tissue adhesions and scarring, tenosynovitis, or inadequate release of the transverse carpal ligament.17-21 Scar tissue formation and scar tethering to the nerve can damage the nerve not only by physical compression but also by disrupting the nerve’s vas-
cular supply. In these cases, reoperation is necessary for nerve release and decompression from scar tissue. However, revision decompression and neurolysis does not completely relieve symptoms because most patients have recurrent scar tissue formation.22,23

Duclos and Sokolow7 have highlighted the importance of normal nerve excursion rather than soft tissue coverage for the treatment of recurrent carpal tunnel syndrome due to median nerve adhesions. These authors7 recommended extensive neurolysis without vascularized flap coverage and reported complete pain relief in 75% of patients at a mean 27.5-month follow-up. However, most surgeons concur that some type of nerve coverage is necessary after neurolysis.24-28 Several local muscle flaps such as the abductor digiti minimi, palmaris brevis, pronator quadratus, and lumbrical have been described to protect the nerve from scarring.24-28 However, dissection of these muscle flaps and adequate median nerve coverage is usually difficult. The hypothenar fat pad flap has been described for median nerve coverage,29 providing excellent pain relief10 and having a failure rate of less than 4.5% for 45 patients managed with this technique.30 Pedicle or free flaps such as the groin, lateral arm, or posterior interosseous have also been described, but with variable outcomes.24,31

Median nerve wrapping techniques have also had variable results.15,24 Varitimidis et al15 reported significant relief of symptoms in 15 patients with recurrent carpal tunnel syndrome at a mean of 43 months using an autologous saphenous vein wrapping technique. However, harvesting vein or muscle grafts is associated with donor site morbidity, and often results in bulky reconstructions and difficult skin closure.24

Alternative synthetic and biodegradable materials such as polyglycolic acid, polycaprolactone, and silastic tubes have been used with variable results for nerve coverage.31-34 In the early 1960s, Kline and Hayes31 used a biodegradable nerve wrap for repair of peripheral nerve defects in chimpanzees. These tubes have had efficacy as conduits for nerve gaps as well as for protection of injured nerves.32-34 Recently, the Canaletto implant (EuroMed, Nimes, France) was introduced for the treatment of median nerve scarring in patients with recurrent carpal tunnel syndrome.35 The aim of using this biological implant is to prevent contraction of the 2 edges of the flexor retinaculum after incision of the retinaculum. The Canaletto implant is applied with its siliconized deep surface in contact with the median nerve. The edges of the implant are sutured to the edges of the retinaculum; thus, a gliding plane for the median nerve is enabled. Using this product, successful treatment of carpal tunnel syndrome was reported in 80% of patients.35 However, the ideal nerve wrap material to protect the nerve from scar tissue and adhesions, minimize inflammatory and immunologic reactions, and improve the excursion and gliding of the nerve has not been confirmed.31-35

NeuraWrap Nerve Protector is an absorbable type I collagen implant derived from bovine deep flexor tendons that may be used for nerve coverage and to protect injured peripheral nerves. It is designed to interpose between the nerve and the surrounding tissue, isolating the former during the healing process. Additionally, through its pores (up to 68 kDa), it allows diffusion of supportive nutrients for the damaged nerve. The collagen nerve wrap remains in place during the active phase of tissue healing and resorbs completely once the tissue response has resolved. Therefore, it does not cause long-term nerve irritation that may necessitate reoperation, and removal of the implant is not required. The indications for the collagen nerve wrap are recurrent carpal tunnel and cu-
bital tunnel syndrome, and coverage of transected and microsurgically repaired peripheral nerves. Its contraindications include infection, possible immunologic response to the material, and poor tissue bed that would require a muscle flap. The advantages of the collagen nerve wrap include off-the-shelf availability, ease of use, availability of sterile, double peel packages in a variety of sizes for single use only, ability to revascularize the damaged nerve, and controlled rate of resorption (range, 36-48 months). Its disadvantages include cost and limited preclinical and clinical data. In peripheral nerve surgery using the collagen nerve wrap or similar products, extension of the previous incision is necessary. External neurolysis of the nerve should be performed, with preservation of the nerve blood supply if possible. Then, the appropriate length of nerve wrap is selected and cut longitudinally according to the length of nerve release. The collagen nerve wrap should be loosely sutured across the longitudinal cut with 2 to 3 separate No. 7-0 nylon sutures. Before wound closure, meticulous hemostasis is required. Extensive tenosynovectomy should be avoided. Additionally, tight wrapping of the nerve could potentially constrict the nerve and thus should be avoided.

The patients in the current study had successful treatment of carpal tunnel syndrome using the collagen nerve wrap for median nerve protection. The first patient had recurrent carpal tunnel syndrome after 2 unsuccessful open carpal tunnel surgeries. The second patient had advanced median nerve compression after previous trauma.

The authors acknowledge that there is little information on the type of previous surgery for the second patient; the carpal tunnel may not have been previously released. However, in both patients, extensive scarring and hourglass deformity was found at the median nerve, without evidence of mechanical compression. Hourglass constructions were meticulously released in both patients; in this setting, the authors also acknowledge that perhaps the tube had nothing to do with recovery. Certainly, both patients did well with the use of the collagen median nerve wrap. Therefore, the clinical results suggest this would be a useful method.

CONCLUSION

Collagen nerve wrap for median nerve protection after scar tissue excision and neurolysis in 2 patients with advanced median nerve compression has been described. The technique is easy, there is no donor site morbidity, and the implant is not associated with complications. Both patients experienced complete symptom relief at the last follow-up. The authors recommend the use of this material in revision nerve surgery for optimum nerve tissue healing.

REFERENCES


29. Cramer LM. Local fat coverage for the median nerve. ASSH Correspondence Newsletter. 1985; 35.


